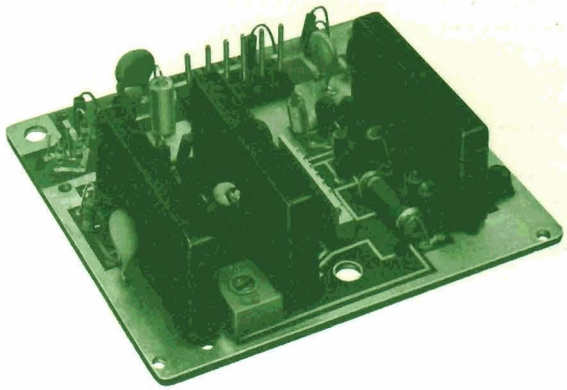
MOBILE RADIO

MASTR® II MAINTENANCE MANUAL

STATION CHANNEL GUARD (ENCODE ONLY)

Maintenance Manual LBI-4877B
DATAFILE FOLDER - DF-5046

CHANNEL GUARD 19C321162G1



SPECIFICATIONS *

TONE FREQUENCIES	71.9 to 203.5 Hertz
POWER REQUIREMENTS	10 VDC @ 25 Milliamperes
NUMBER OF INTEGRATED CIRCUITS	4
TEMPERATURE RANGE	-40°C (-40°F) to +70°C (158°F)
ENCODE TONE DISTORTION	1%
ENCODE RESPONSE TIME	25 Ms
FREQUENCY STABILITY	±0.5%

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

TABLE OF CONTENTS

ILLUSTRATIONS

WARNING

No one should be permitted to handle any portion of the equipment that is supplied with high voltage; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

DESCRIPTION

In full duplex and repeater MASTR II stations, Channel Guard Encode Only Board 19C321162G1 is used along with the 19D417261G6 Channel Guard Decode Only Board. The Encode Only Board is also used where different encode and decode tone frequencies are required. The 19C321162G1 board is mounted on the Radio Panel Front Door adjacent to the transmitter exciter (refer to the Installation Diagram).

The Channel Guard Encode Only Board utilizes thick film integrated circuits (IC's) and discrete components for maximum reliability. Tone frequencies are selected by plug-in "Versatone" tone networks that can be easily changed.

The encoder provides tone-coded modulation to the transmitter. All MASTR®II transmitters have a Channel Guard Modulation Control which is set in accordance with the Transmitter Alignment Procedures (see the Transmitter MAINTENANCE MANUAL).

Channel Guard is a continuous-tone controlled squelch system that provides communications control in accordance with EIA standard RS-220. The basic Channel Guard system utilizes standard tone frequencies from 71.9 to 203.5 Hertz, with the encoder and decoder normally operating on the same frequency. The standard Channel Guard tone frequencies are listed in the following chart.

STANDARD TONE FREQUENCIES				
71.9	88.5	107.2	131.8	162.2
74.4	91.5	110.9	136.5	167.9
77.0	94.8	114.8	141.3	173.8
79.7	97.4	118.8	146.2	179.9
82.5	100.0	123.0	151.4	186.2
85.4	103.5	127.3	156.7	192.8
				203.5

A Squelch Tail Elimination (STE) circuit in the encoder uses a phase shift of approximately 225° to eliminate undesirable noise bursts after each transmission.

Options 9534 and 9535 provide the Channel Guard Encode Only board for use in simultaneous encode and decode duplex systems. Refer to the Installation Diagram (See Table of Contents) for instructions on installing this board in the exciter compartment of the station transmitter. Option 9535, which is designed for multi-frequency transmit remote duplex systems, requires the Squelch Tail Eliminator Board 19A130001G1. Refer to the Remote Control Shelf MAINTENANCE MANUAL for a description of this board.

CIRCUIT ANALYSIS

Four integrated circuit (IC) modules together with associated discrete components comprise the Channel Guard Encode Only assembly. The IC's consist of the Filter/Limiter Hybrid, the Selective Amplifier Hybrid, the Encode Hybrid and the Tone Network. The Selective Amplifier and Tone Network function together to form the Frequency Switchable Selective Amplifier (FSSA). The FSSA, when properly calibrated, provides maximum flexibility in Channel Guard tone selection. By replacing the plug-in "Versatone" Tone Network with another of the desired frequency, the Channel Guard operating frequency can be changed. No adjustments are required.

Typical diagrams of the FSSA and Encoder are shown in Figures 1 and 2. References to symbol numbers mentioned in the text are found on the Schematic Diagram, Outline Diagram and Parts List.

Amplifier/Limiter Hybrid

When the transmitter is keyed, A- is applied to the encode start circuit in the Encode IC. The Encode IC completes a positive feedback path from the FSSA output to the Filter/Limiter Hybrid Amplifier and generates an encode start pulse. This pulse is applied to the amplifier/limiter through discrete components C4 and L2. This causes the FSSA to oscillate at the tone frequency.

Frequency Switchable Selective Amplifier (FSSA)

The FSSA generates the selected encode tone. Having a nominal Q of 60, the frequency response characteristics of the FSSA are similar to that of a parallel resonant LC tank circuit. The Q is determined by R1 in the Tone Network. R1 is selected for each operating frequency. Frequency calibration control R5 is preset at the factory using a precision reference Tone Network with an operating frequency of 139.64 Hertz.

Once calibrated, the operating frequency and Q of the circuit are controlled by the Tone Network. Specifically, the operating frequency is controlled by the resistance ratio of R2 to R3 in the Tone Network; the Q is determined by R1. The frequency stability of the FSSA is ±0.5%. R5 in the Tone Network sets the DC loop bias.

Encode Control Circuits

When the PTT switch is depressed, A- from the PTT circuit in the Encode IC is coupled to the Channel Guard decoder to disable it. The encode switch Q7 controls the positive feedback path from the FSSA to the Filter/Limiter Amplifier by applying A- to the signal path at the junction of R19 and R20.

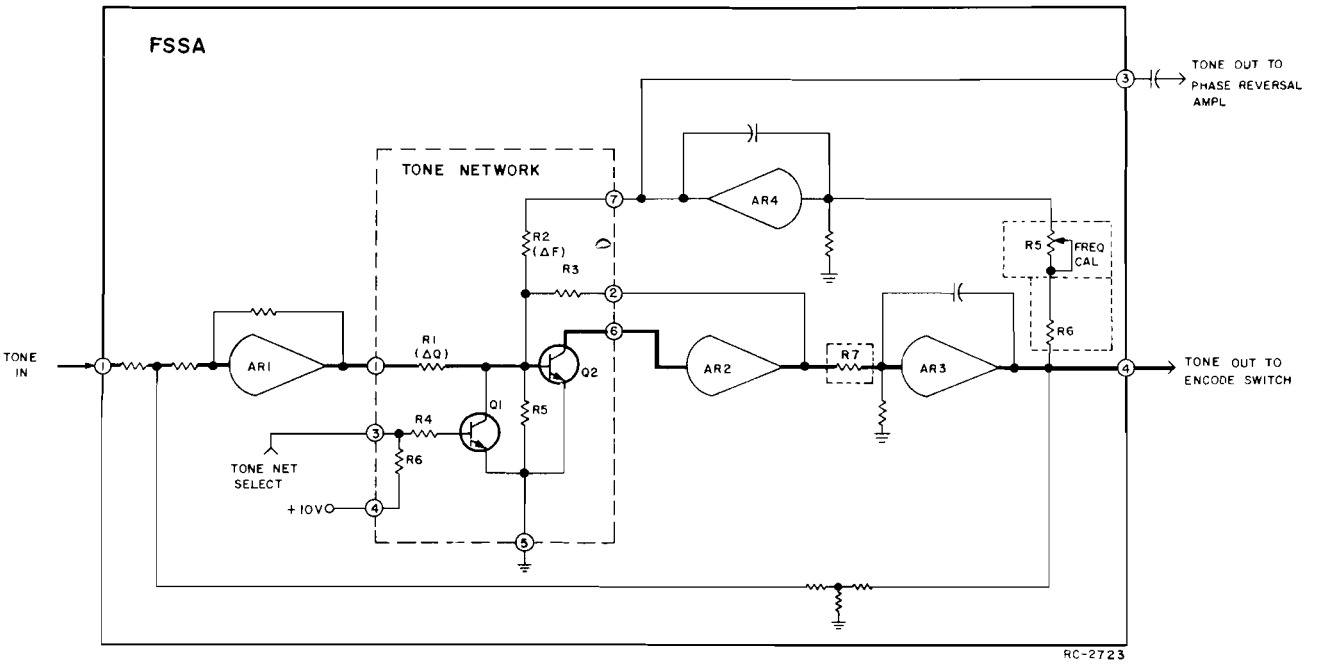


Figure 1 - Frequency Switchable Selective Amplifier (FSSA)

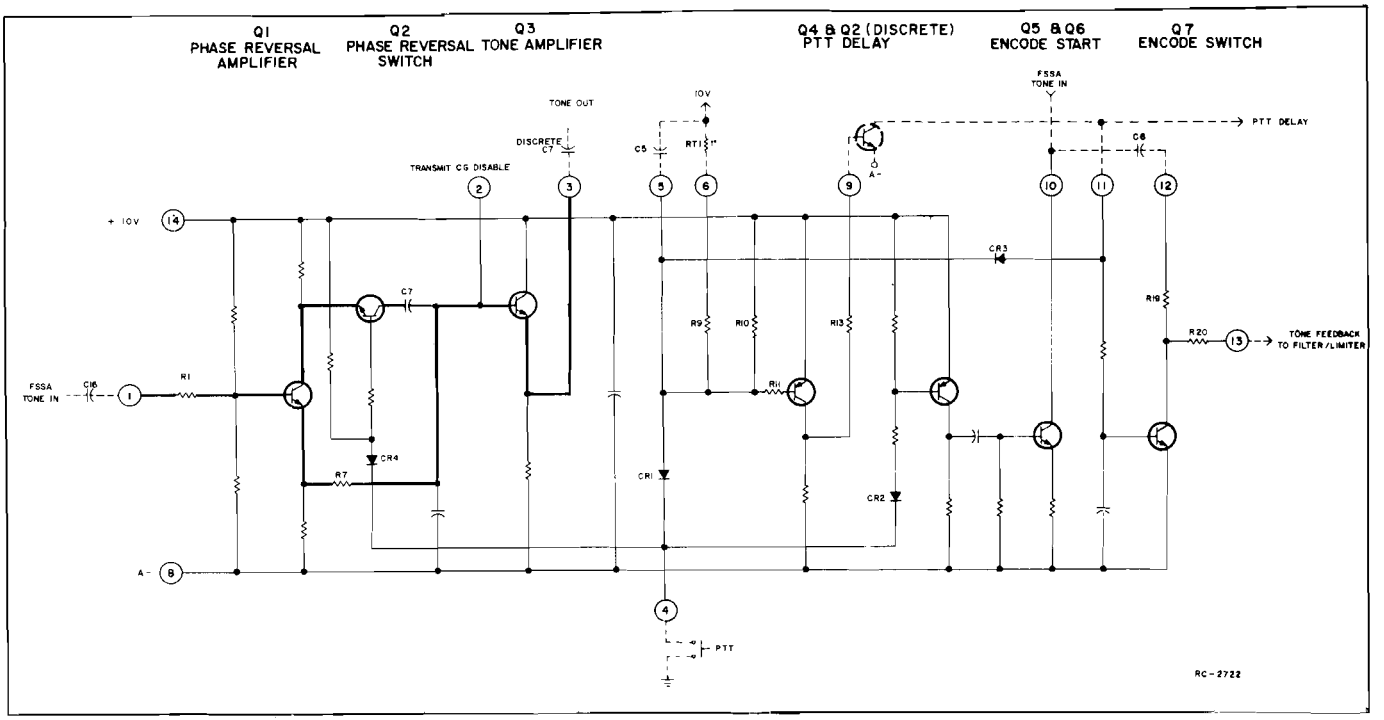


Figure 2 - Typical Encode Circuit

When the PTT switch is operated, A- is applied to the base of Q7 through discrete transistor Q2 (connected to pin 9 of the Encode IC). Q7 immediately turns off, removing A0 from the junction of R19 and R20 and completing the positive feedback path to allow the FSSA to oscillate. The circuit remains in this state until PTT turns off. Q2 is controlled by the PTT delay circuit and holds encode switch Q7 off for approximately 160 milliseconds to allow the STE circuit to function.

When the PTT switch is operated, Q5 turns on. A positive pulse is coupled to the base of Q6. Q6 pulses on momentarily, pulling the output of the FSSA to ground. This results in a rapid initiation of the oscillator at the Channel Guard frequency.

Phase Reversal and STE

By controlling the conduction of switch Q2 in the Encode IC, the tone may be taken from either the collector or emitter of phase reversal amplifier Q1. When the PTT switch is operated, the FSSA generates the encode tone which appears at the base of Q1. Diode CR4 is forward biased, applying A- to the base of Q2, turning Q2 off. Under this condition, the encode tone is coupled from the emitter of Q1 through R7 to the base of emitter follower Q3. The encode tone output is in phase with the input tone at the base of Q1.

When the PTT switch is released, diode CR4 is biased off and the base of Q2 rises toward +10 VDC, turning Q2 on. Conduction of Q2 allows the encode tone to be coupled from the collector and emitter of Q1 and summed at the base of Q3. The encode tone is now taken from the emitter of Q3 and applied to the transmitter through pin 3 of the encoder. The tone is now 235 degrees out of phase from the PTT phase and at a level greater than 250 millivolts RMS.

The transmitter carrier is transmitted for a period of 160 ms after the PTT switch is released to allow sufficient time for the receiver to detect the phase reversal in the tone. The receiver is thus muted, eliminating the squelch tail. The delay in the transmit carrier drop out is determined by the RC time constant of discrete components C5 and RT1 along with R9, R10 and R11 in the Encode IC.

Channel Guard Encode Disable

The Channel Guard encode function can be disabled from an externally controlled source. Applying ground to any one of the mute inputs (H1, H2 or H3) forward biases the diode associated with that input (CR1, CR2, CR3, and turns on discrete transistor Q3. Conduction of Q3 turns on discrete transistor Q1, supplying A- to pin 2 of the Encode IC. Emitter follower Q3 in the Encode IC is turned off, preventing the tone from passing to the transmitter. When discrete transistor Q3 conducts, C2 is charged. Removing the input ground from the CG MUTE input immediately turns off Q3, but Q1 continues to conduct until C2 discharges. Thus the CG disable function is maintained for approximately 160 milliseconds after CG MUTE is removed.

MAINTENANCE

Troubleshooting the Channel Guard Encode Only assembly is facilitated by removing the three 6-32 screws holding the board to the door assembly, and lifting the board to gain access to the solder side of the board. The following Troubleshooting Chart contains typical voltage and waveform data taken at selected points on the Channel Guard board.

SYMPTOM	PROCEDURE
Channel Guard does not encode.	1. Key the transmitter. Check for presence of correct waveform at (A). If waveform is correct, check for failure in the exciter. 2. Check for presence of +10 VDC at (B). 3. Check for presence of A- at (C). 4. Bridge J1-5 to J1-6. Check for proper waveform at (A). If waveform is present, failure exists in Encode ICOR discrete transistor Q2. 5. Isolate defective component by verifying proper waveforms at (D) and (E). 6. Tone Network may be checked by substituting known good one.

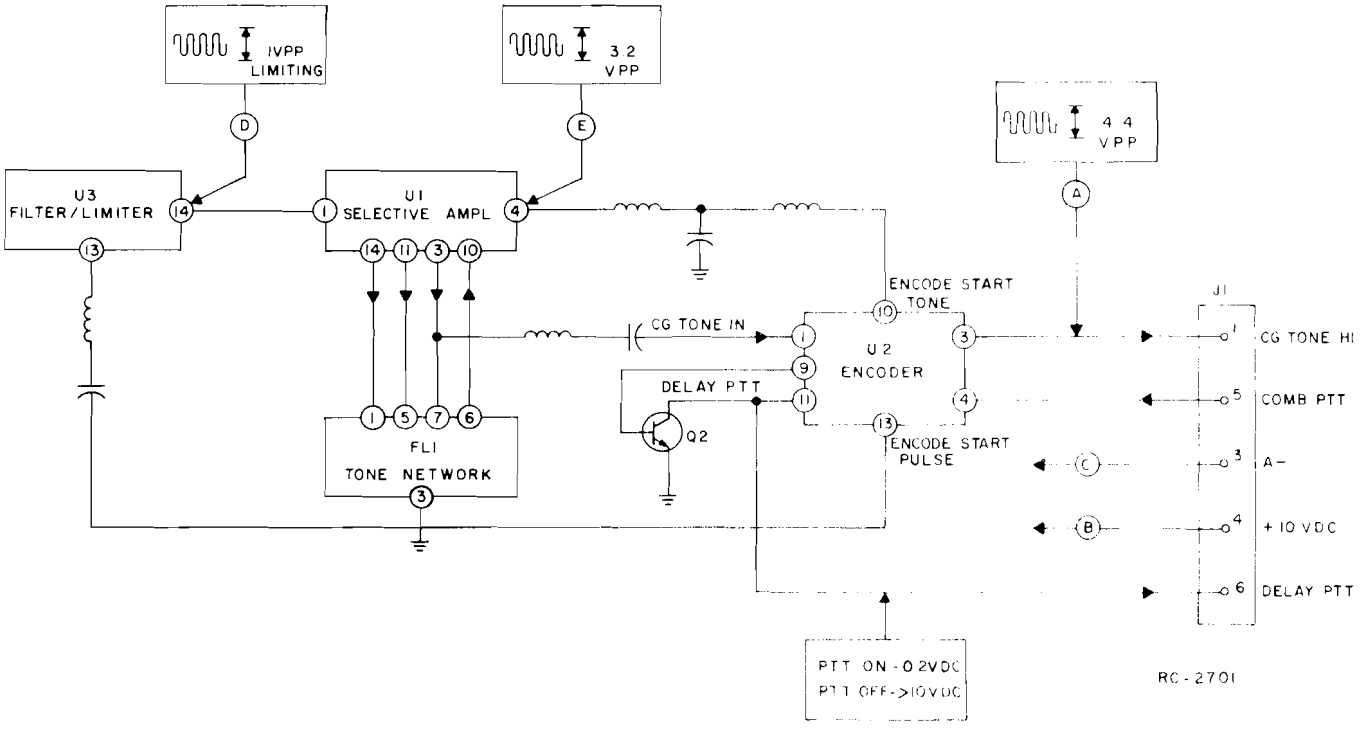
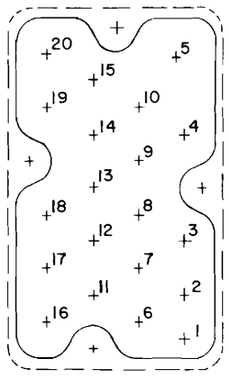
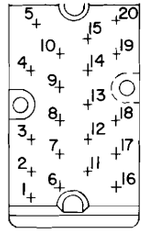


Figure 3 - Troubleshooting Chart



VIEW AT "B"
VIEW FROM WIRING END
OF J933



VIEW AT "A"
NUMBERING FROM
WIRING END FOR P6 & P8

(19D417795, Rev. 4)

INSTRUCTIONS.

1. REMOVE COVER PL19C320673G1.
2. MOUNT CHANNEL GUARD PL19C321162G2 BOARD ASM. AS SHOWN USING HARDWARE SUPPLIED.
3. AT P8 (PART OF STATION HARNESS 19C320811) REMOVE WIRES FROM P8-2 AND P8-3 AND INDIVIDUALLY TAPE ENDS.
4. INSTALL (SOLDER) ORANGE WIRES SUPPLIED, BETWEEN P6-7 AND P8 AND BETWEEN P6-8 AND P8-2.
5. REMOVE WIRES FROM J933-2 AND J933-3 AND CUT ENDS AS SHORT A POSSIBLE.
6. INSTALL (SOLDER) PL19B226485G1 HARNESS TO J933 AS FOLLOWS: (SEE VIEW AT "B" & FIG.1)
   SF22-BK TO J933-4
   SF22-BL TO J933-3
   SF22-R TO J933-7
   SF22-BR TO J933-2
7. AT P901 PART OF EXCITER HARNESS PL19D417262G3 REMOVE CONTACT FROM P901-3, AND CUT WIRE AS SHORT AS POSSIBLE. (USE TOOL 19B219951P1 TO REMOVE CONTACT). INSTALL N22-G WIRE FROM PL19B226485G1 HARNESS IN P901-3.
8. INSTALL P1 OF HARNESS PL19B226485G1 ON J1 ON CHANNEL GUARD BOARD PL19C321162G1 AS SHOWN.
9. INSTALL FL1 AS SHOWN.
10. INSTALL COVER PL19C320673G1.

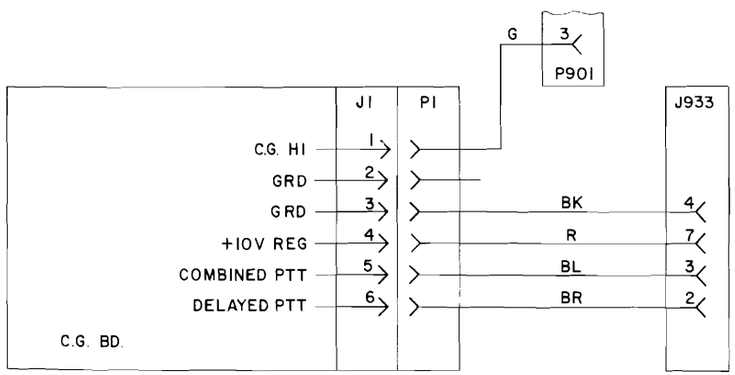
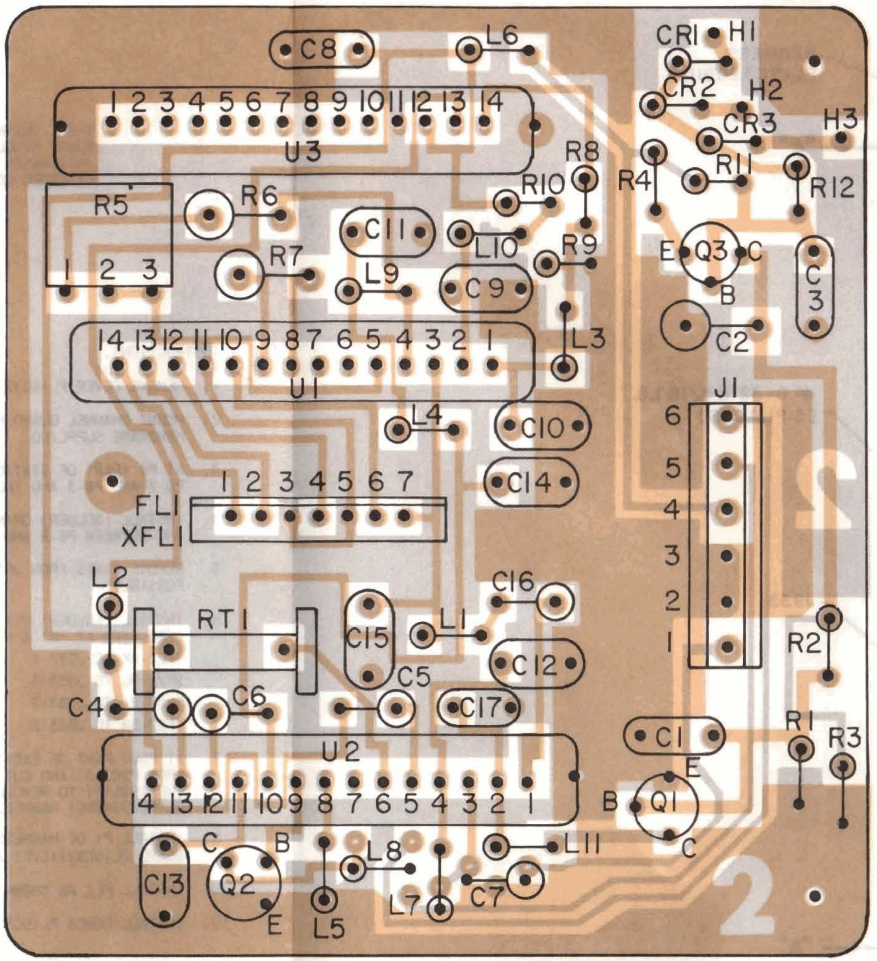


FIG. 1

INSTALLATION INSTRUCTIO

STATION ENCODE O
CHANNEL GUARD 19C32116

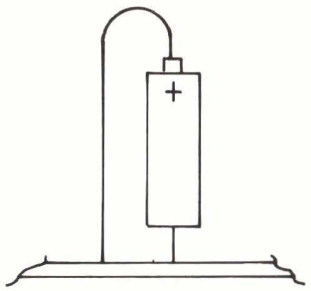


RUNS ON SOLDER SIDE

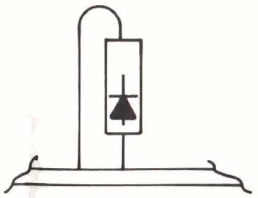
RUNS ON BOTH SIDES

RUNS ON COMPONENT SIDE

(19C321605, Rev. 0)
(19C321160, Sh. 2, Rev. 2)
(19C321160, Sh. 3, Rev. 2)

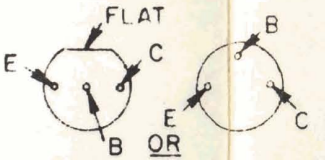


POLARITY FOR C2, C4 - C7 & C16



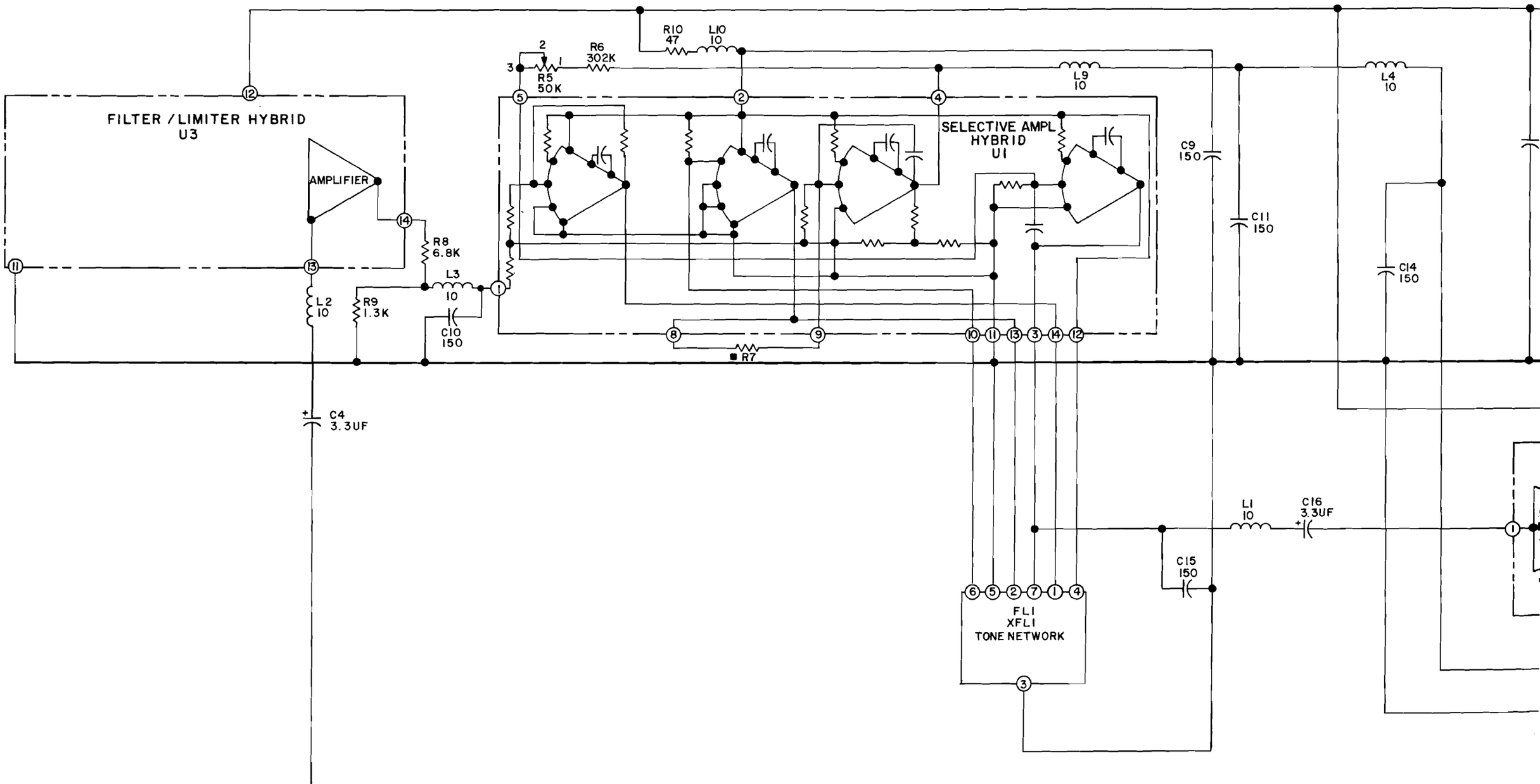
POLARITY FOR CR1 - CR3

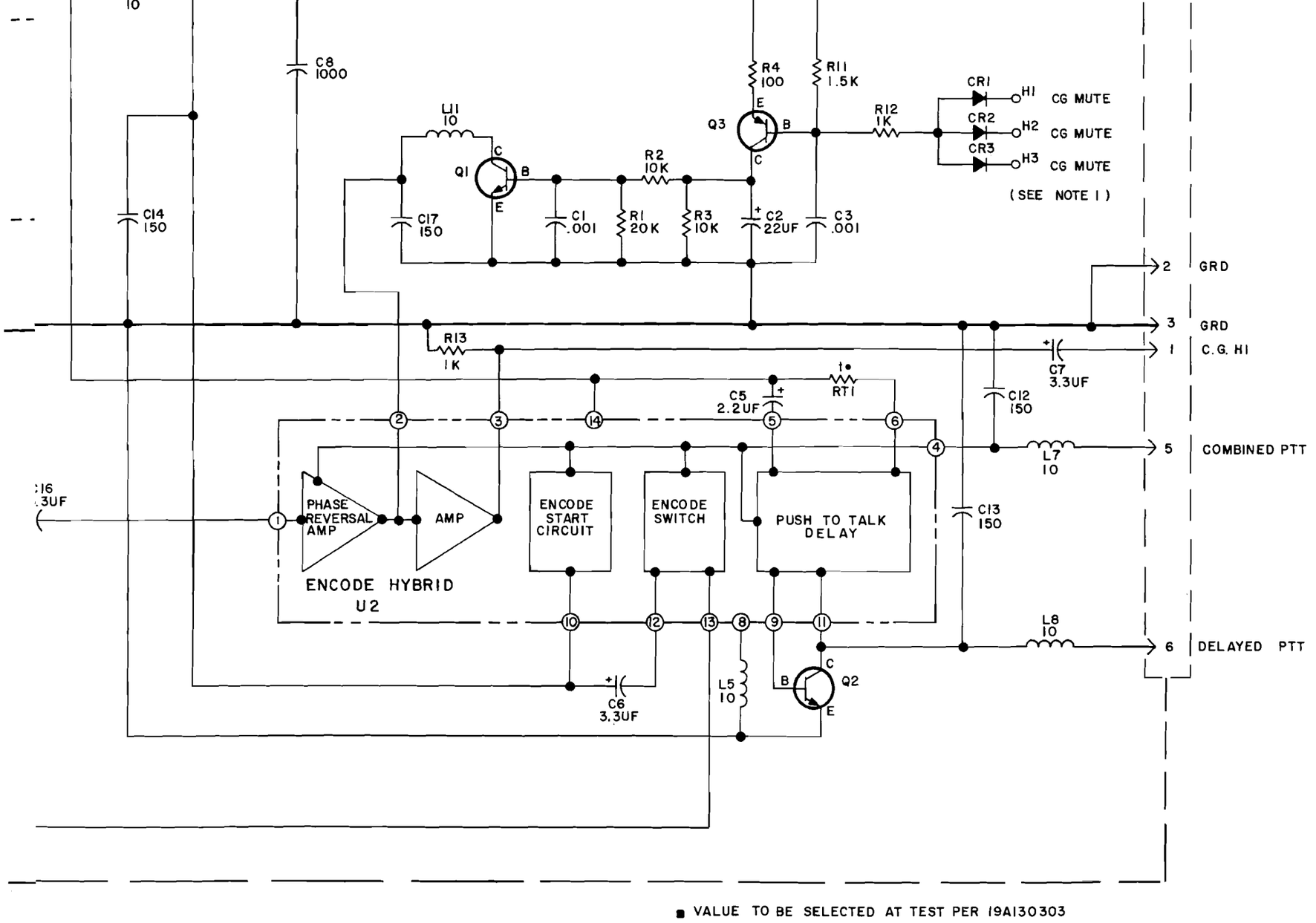
LEAD IDENTIFICATION
FOR Q1, Q2 & Q3



IN-LINE TRIANGULAR
VIEW FROM LEAD END

NOTE LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION


FILTER / LIMITER HYBRID
U3
AMPLIFIER
SELECTIVE AMPL
HYBRID
U1
R10
47
L10
10
R6
302K
R5
50K
L9
10
L4
10
C9
150
C11
150
C14
150
R8
6.8K
L3
10
L2
10
R9
1.3K
C10
150
R7
C4
3.3UF
L1
10
C16
3.3UF
C15
150
FL1
XFL1
TONE NETWORK



■ VALUE TO BE SELECTED AT TEST PER 19A130303

(19R622080, Rev. 2)

NOTE 1.
IN ORDER TO TRANSMIT ON F1, F2, F3 OR F4 WITHOUT SENDING CG TONE, STRAP H1, H2 OR H3 TO THE FREQUENCY SELECT LEAD OR GROUND H1, H2 OR H3.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19C321162G1	A

SCHEMATIC DIAGRAM

STATION ENCODE ONLY
CHANNEL GUARD 19C321162G1

		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C2	5496267P210	Tantalum: 22 µf ±10%, 15 VDCW; sim to Sprague Type 150D.
C3	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C4	5496267P9	Tantalum: 3.3 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C5	5496267P413	Tantalum: 2.2 µf ±5%, 20 VDCW; sim to Sprague Type 150D.
C6 and C7	5496267P9	Tantalum: 3.3 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C8	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C9 thru C15	5494481P101	Ceramic disc: 150 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C16	5496267P9	Tantalum: 3.3 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C17	5494481P101	Ceramic disc: 150 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 thru CR3	19A115250P1	Silicon.
		- - - - - - - - - TONE NETWORKS - - - - - - - -
		NOTE: When reordering give GE Part Number and specify exact frequency needed.
FL1	19C320291G1	Hybrid. 71.9 - 203.5 Hz.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J1	19A116659P12	Connector, printed wiring: sim to Molex 09-64-1061.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1 thru L11	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4.
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q1 and Q2	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q3	19A115852P1	Silicon, PNP; sim to Type 2N3906.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R152P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R2 and R3	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R4	3R152P101J	Composition: 100 ohms ±5%, 1/4 w.
R5	19A116559P114	Variable, cermet: 50,000 ohms ±20%, .5 w; sim to CTS Series 360.
R6	19A116793P3023	Metal film: 302,000 ohms ±1%, 1/4 w.
R7A	19A116793P1803	Metal film: 180,000 ohms ±1%, 1/4 w.
R7B	19A116793P1913	Metal film: 191,000 ohms ±1%, 1/4 w.
R7C	19A116793P1693	Metal film: 169,000 ohms ±1%, 1/4 w.
		- - - - - - - - - THERMISTORS - - - - - - - -
RT1	5490828P12	Thermistor: 25,000 ohms ±10%, color code red; sim to Carborundum 783H-2.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19D417186G1	Hybrid, Amplifier.
U2	19D416740G2	Encode Hybrid.
U3	19D416741G4	Filter/Limiter, Hybrid.
		- - - - - - - - - - SOCKETS - - - - - - - - -
XFL1	19C320299G1	Socket: 7 contacts.
		- - - - - - - - - - MISCELLANEOUS - - - - - - -
	N80P13005C6	Machine screw: No. 6-32 x 5/16.
	N404P14C6	Lockwasher, internal tooth: No. 6.
	19B226485G1	Harness.

ORDERING SERVICE PARTS

Each component appearing on the schematic diagram is identified by a symbol number to simplify locating it in the parts list. Each component is listed by symbol number, followed by its description and GE Part Number.

Service parts may be obtained from Authorized GE Communication Equipment Service Stations or through any GE Radio Communication Equipment Sales Office. When ordering a part, be sure to give:

1. GE Part Number for component
2. Description of part
3. Model number of equipment
4. Revision letter stamped on unit

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired, or should particular problems arise which are not covered sufficiently for the purchaser's purposes, contact the nearest Radio Communication Equipment Sales Office of the General Electric Company.

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

GENERAL ELECTRIC

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